EXECUTIVE SUMMARY
REVISED DRAFT FEASIBILITY STUDY TECHNICAL REPORT
LEHIGH CEMENT COMPANY CLOSED CKD PILE
METALINE FALLS, WASHINGTON

INTRODUCTION

This Revised draft Feasibility Study Technical Report (Revised dFSTR) documents the results of the evaluation of the groundwater-related remedial alternatives[1] for the Closed Cement Kiln Dust (CKD) Pile in Metaline Falls, Washington (Site). Lehigh Cement Company (Lehigh) developed the Revised dFSTR in accordance with the Model Toxics Control Act (MTCA) regulations in Washington Administrative Code (WAC) 173-340-350 et. seq. the Agreed Order AO No. DE99HS-E941A6 (1999 AO), between Lehigh (Lehigh) and the Washington Department of Ecology (Ecology).

BACKGROUND

Lehigh operated a Portland cement production plant in Metaline Falls, Washington, from the early 1900s until 1989. CKD was generated at the plant as a by-product of the cement production process. Lehigh periodically moved the dust by-product from the production plant to the CKD pile, which is between the former plant location and State Route 31 (see Exhibit ES-1). The Closed CKD Pile contains approximately 544,000 metric tons of material [Dames and Moore, 1995]. Lehigh owns the Closed CKD Pile.

Ecology began its regulatory oversight of the investigation/remediation of the Site in 1991. Lehigh has implemented remedial actions at the Site since 1996 to address potential exposure pathways as described in Exhibit ES-2. Specifically, the

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[1] This Feasibility Study (FS) evaluates remedial alternatives for addressing groundwater at the Metaline Falls Site. This is consistent with the 1999 Agreed Order No. DE-99HS-E941. This is appropriate as other potential risks have been addressed by previous remedial activities (e.g., direct contact with CKD prevented by approved cap placed on CKD pile). Surface water concerns will be addressed by the remediation of the CKD-affected groundwater that seeps to Sullivan Creek.

cover and surface water management facilities at the Closed CKD Pile adequately control these potential pathways:

- Direct contact;
- Inhalation;
- Precipitation-derived percolation into the CKD; and
- Surface water-derived infiltration to the CKD.

The CKD-affected groundwater downgradient of the Closed CKD Pile is localized and under property owned by Lehigh, except for a portion of Washington State Route 31. Additional details on the nature and extent of the affected groundwater are given in the Remedial Investigation (RI) Technical Report [GeoSyntec, 2001] and in the Interim Progress Report on Subsurface Treatability Study [GeoSyntec, 2000].

The CKD-affected groundwater flows north-northeasterly from the Closed CKD Pile, across the area downgradient of the Closed CKD Pile, and into Sullivan Creek. The area of the groundwater aquifer affected by CKD is not currently, nor is it anticipated to be, withdrawn for domestic use. Restrictive covenants will be recorded to ensure continued nonuse. Further groundwater remediation is required to bring the groundwater into compliance with cleanup standards. These actions will also protect surface water in Sullivan Creek.

FEASIBILITY STUDY

Lehigh conducted the Feasibility Study in accordance with the Ch.173-340 WAC and the 1999 AO. To provide the necessary technical information and analysis to select the groundwater remedy, GeoSyntec undertook literature reviews, document searches, conducted laboratory bench-scale and field pilot-scale treatability testing and prepared reports, technical memoranda, and design submittals for Ecology review including:

1. Interim Progress Report No. 1, Subsurface Treatability Study, GeoSyntec, submitted in 2000.

2. Feasibility Study Technical Memorandum (FSTM), GeoSyntec, submitted in 2003.

3. Pilot System In Situ Treatment Wall Design Drawings, GeoSyntec, submitted in 2001.

4. Pilot System In Situ Treatment Wall Construction Report, GeoSyntec, submitted in 2003.

5. Quarterly Project Status Reports, GeoSyntec, submitted in 2000, 2001, 2002, 2003, 2004, and 2005.

6. Project Status Meetings between Lehigh and Ecology in 2002, 2003, and 2004.

7. Supplement to the initial dFSTR, GeoSyntec, submitted in 2004.

Following submittal of the initial draft FSTR in November 2003, Lehigh and Ecology began discussions about additional Site investigations, based on Ecology's belief that data from additional investigations would bolster the dFSTR. In May 2004, Lehigh submitted the Supplement to the Draft Feasibility Study Technical Report and Technical Response to the Department of Ecology Request for Further Field Investigation [GeoSyntec, 2004] to address Ecology's data needs. Ecology then conducted a limited field investigation in July 2004. Ecology's investigation is documented in their letter report, dated 25 October 2004, and is included in the dFSTR (see Appendix B).

Groundwater Remedy Alternatives

The FSTM screened 20 groundwater remedy alternatives [GeoSyntec, 2003]. Lehigh determined that five alternatives passed the screening criteria and recommended that they be evaluated more extensively in the FSTR. After its review of the FSTM, Ecology recommended that the FSTR also include source abatement alternatives (i.e., Additional Source Control and Partial Source Removal[2]). The FS process, which included further discussions with Ecology, led to the inclusion of two more alternatives. It also led Lehigh to drop one alternative from further consideration and to consolidate three technologies into a single alternative. Accordingly, the following alternatives are evaluated in this Revised dFSTR – See Exhibit ES-3.

- Alternative #1 – Permeable Treatment Wall (PTW)
- Alternative #2 – Groundwater Control (GWC)
- Alternative #3 – Additional Source Control (ASC)
- Alternative #4 – Partial Source Removal (PSR)
- Alternative #5 – Funnel and Gate Treatment (FGT)
- Alternative #6 – Partial Additional Source Control (PASC)

PTW (*Alternative 1*) extends the existing Pilot System treatment zone along the east side of State Route 31. CKD-affected groundwater passes through a treatment zone prior to migrating to Sullivan Creek. To address possible gaps between the treatment panels, PTW includes a limited number of wells that will extract water. This groundwater will be routed back to the treatment zone.

GWC (*Alternative 2*) continues operation of the existing pilot PTW and adds extraction wells to capture the remaining CKD-affected groundwater plume. The extracted groundwater is treated aboveground to meet cleanup standards by reducing the pH and precipitating the arsenic. The treated groundwater is discharged to Sullivan Creek.

ASC (*Alternative 3*) includes a low permeability vertical barrier (i.e., slurry wall) hydraulically upgradient of the Closed CKD Pile to direct water away from the CKD, with dewatering wells on the upgradient side of the slurry wall to capture and re-route the water around the Closed CKD Pile. The slurry wall keys into the underlying aquitard that ranges from approximately sixty to 120 feet deep. The slurry wall and dewatering wells achieve source control by reducing the amount of water that contacts CKD. ASC generates less CKD-affected water, but does not eliminate it. Inherent

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[2] 6/11/03 Ecology correspondence to Eric Smalstig, GeoSyntec Consultants, and follow-up Ecology correspondence with Jay Manning, Esq., Brown Reavis & Manning, PLLC.

permeability and potential imperfections in the slurry wall, combined with possibility of water upwelling into the base of the Closed CKD Pile, prevent ASC from completely eliminating the generation of CKD-affected water. Thus, ASC includes downgradient groundwater extraction and aboveground treatment components. The downgradient systems are flexible, allowing modification over time as the benefits of the upgradient slurry wall and dewatering wells are realized.

PSR (*Alternative 4*) uses sheet piles to isolate and stabilize a portion of the toe of the Closed CKD Pile and then removes approximately 5,500 cubic yards to access the CKD that Ecology documented is in contact with groundwater under the toe [Ecology, 1997]. The PSR alternative also involves accessing CKD through the top deck of the Closed CKD Pile by removing a portion of the engineered cover, and excavating CKD using conventional slope back techniques. Excavating this area of CKD through the top deck involves removing approximately 260,000 cubic yards of CKD to access the CKD in contact with groundwater at the lower reaches of the pile [Ecology, 1997]. PSR requires the construction of a temporary storage area of about five acres in size, to hold the dangerous waste during excavation and backfilling. PSR places a non-reactive engineered fill and geotextile layers into the excavated area and then places the temporarily-stockpiled CKD back into the excavation. The CKD that does not fit back into the excavation will be hauled off-site for disposal. PSR includes reconstructing the breached and damaged engineered cover. Ecology suggested that the PSR evaluation include an assumption that only short-term groundwater treatment (five years) would be needed downgradient of the Closed CKD Pile after implementing the CKD removal operations of PSR. Lehigh has presented data and analysis showing that PSR will not be effective enough to obviate groundwater treatment over the long term. Lehigh developed two scenarios to evaluate PSR: scenario one assumes that the Site meets cleanup levels after five years and scenario two assumes that the Site needs indefinite treatment to meet clean up levels.

FGT (*Alternative 5*) installs a system of shallow (ten to twenty feet deep) subterranean slurry walls and gravel drainage layers downgradient of the Closed CKD Pile. The slurry walls and drainage layers funnel groundwater toward a central treatment corridor, where the water is treated in situ with the technology used in the Pilot System and described in *Alternative 1*, PTW. Although FGT is not a flexible alternative, FGT offers a higher degree of hydraulic control than PTW while still using in situ treatment technology tested in the Pilot System at the Site. A subsurface discharge corridor conveys the treated water to Sullivan Creek.

PASC (*Alternative 6*) pursues two concepts in remediation: source control and downgradient in situ treatment. PASC supplements the FGT remedy with a gravity drain installed under the Closed CKD Pile. The gravity drain is a source control technology that captures and redirects unaffected groundwater away from the Closed CKD Pile. The gravity drain intercepts water that would eventually contact and inundate the CKD. The amount of downgradient treatment will decrease with time as inundated CKD is dewatered due to the gravity drain and the transient drainage in the Closed CKD Pile reaches an equilibrium condition.

Evaluation Criteria

This Revised dFSTR uses the following criteria, identified in MTCA and the 1999 AO to evaluate each of the six alternatives.

- WAC 173-340-360(2)(a) Threshold Criteria:
  - Protect human health and the environment
  - Comply with cleanup standards
  - Comply with applicable federal and state requirements (ARARs)
  - Provide for compliance monitoring.
- WAC 173-340-360(2)(b) "Other Requirements":
  - Use permanent solutions to the maximum extent practicable (analysis is based on the disproportionate cost test described below)
  - Provide for a "reasonable restoration timeframe" to meet cleanup standards

- Consider public concerns.

- WAC 173-340-360(3)(f) Evaluation Criteria ("Disproportionate Cost Analysis"):
  - Protectiveness
  - Permanence
  - Cost
  - Effectiveness over the long term
  - Management of short-term risks
  - Technical and administrative implementability
  - Consideration of public concerns (considered under "other requirements")

- 1999 AO Additional Criterion:
  - Prevent Domestic Use of CKD-affected Groundwater.

Comparison of Alternatives

All alternatives meet the threshold criteria, so this summary omits that discussion. The comparison focuses on the differences between the alternatives, which involve the elements that MTCA considers under the analysis of cost-disproportionality. MTCA gives preference to permanent remedies. Lehigh's evaluation shows that no permanent remedy exists for the Site. Lehigh understands that according to Ecology PSR is a permanent remedy given certain conditions. Although Lehigh and Ecology disagree whether PSR is permanent, they agree that it exhibits the highest degree of permanence of the alternatives evaluated in the Revised dFSTR. Therefore, Lehigh and Ecology agree that PSR is the baseline against which other alternatives are compared. Each of the alternatives except PSR (scenario one) is a long-term treatment based alternative. Therefore with respect to the restoration timeframe criterion each has the same ranking.

Protectiveness: All alternatives present some short-term risks during construction. However, the construction risks associated with PSR, and to a lesser extent ASC, are significant. PSR also has the largest volume of material (untreated CKD) requiring off-site disposal. ASC and GWC involve off-site disposal of non-hazardous treatment residuals. The other three alternatives (PTW, FGT, and PASC) do not generate wastes requiring off-site disposal. Finally, all alternatives are expected to reduce risks at the Site to the same degree and in approximately the same time frame, with the exception of the first PSR groundwater treatment scenario (i.e., PSR with short-term treatment). Under that scenario, PSR would reduce risks over a larger area than other alternatives. Considering the factors that contribute to protectiveness, PASC ranks highest, followed by PTW, GWC, FGT, and ASC. PSR ranks lowest under either groundwater treatment scenario.

Permanence: All alternatives provide a high degree of permanence because they treat (i.e., reduce toxicity and mobility of hazardous substances) groundwater by permanently neutralizing the pH and decreasing arsenic concentrations to meet cleanup levels. PSR, ASC, and PASC provide even higher degrees of permanence because they include source control components that reduce the volume of hazardous substances in groundwater. Because PSR has the potential for the greatest reduction in hazardous substance volume, it ranks the highest for permanence, followed by ASC, PASC, FGT, PTW, and GWC.

Cost: The least expensive alternative is GWC, followed by PTW, FGT, and PASC. ASC is two or three times more costly than GWC, and the cost of PSR is an order of magnitude higher than GWC.

Effectiveness Over the Long Term: All alternatives will be effective over the long term. All incorporate treatment technologies that have proven successful. In addition, PSR and PASC incorporate source control components that will reduce the volume of hazardous substances. However, PSR may lose some effectiveness over time, as hydrogeologic conditions at the Site change. ASC also incorporates source control in the form of a slurry wall, but it will be difficult to maintain this wall over the long term. If the wall deteriorates or fails, ASC will lose some of its effectiveness. The source control component of PASC is expected to remain reliable over time. On this criterion, PASC and PSR (groundwater treatment scenario one) rank highest, followed by PTW, GWC, FGT, and PSR (groundwater treatment scenario two). ASC ranks lowest.

Management of Short-Term Risks: PASC, PTW, GWC, and FGT use relatively conventional construction practices, each involving short-term risks that are easily managed. While ASC uses a conventional technology, there is a danger that construction will activate the historic landslide area. Thus, ASC poses significant short-term risks. PSR also uses conventional technologies, but applies them in a soft soil that is unstable and subject to liquefaction. Furthermore, PSR requires workers to excavate and manage very large volumes of CKD, a dangerous waste. Hundreds of truckloads of CKD will be transported off-site for disposal. Thus, PASC, PTW, GWC, and FGT rank the highest on this criterion. The ASC alternative ranks below these alternatives, and PSR ranks lowest.

Technical Implementability: While all of the alternatives can be implemented, PASC, PTW, GWC, and FGT present far fewer technical implementation challenges than either ASC or PSR. ASC requires work in the vicinity of the historic landslide. PSR requires handling significant quantities of CKD, excavating CKD under liquefiable conditions, counteracting CKD slope instability, transporting CKD on public roads, and temporarily storing CKD before either backfilling or shipping off-site for disposal. Thus, GWC, PTW, FGT, and PASC rank highest, while ASC and PSR rank lowest on this criterion.

Administrative Implementability: Lehigh owns the land needed to implement GWC, PTW, and FGT. It may need to acquire or obtain access to other land to implement PASC, ASC, and PSR. For PSR, Lehigh will need approximately five acres of land on which to temporarily store CKD. All alternatives will require Lehigh to obtain an NPDES permit to discharge treated groundwater, except for PTW. Considering these factors, PTW ranks the highest, followed by FGT, GWC, PASC, ASC (at approximately the same ranking), and finally PSR ranks the lowest.

Schedule: GWC has the shortest installation schedule, followed by FGT. PTW and PASC require approximately one additional month to install. ASC requires approximately two additional months. PSR has by far the longest construction schedule, approximately three years longer than the other alternatives.

Public Concerns: The public has not had an opportunity yet to review these alternatives. The MTCA process allows the public several opportunities to provide input on remedy selection. The public will have an opportunity to comment on this Revised dFSTR, and Ecology will address public concerns before finalizing this document. Therefore, public comments will be considered for each of the alternatives upon receipt of the comments, giving each alternative the same ranking at this time for this criterion.

Based on the factors in the disproportionate cost analysis, the cost of PSR, in terms of dollars, difficulty in implementation, and short-term risks, is disproportionate to its potential benefits under either groundwater treatment scenario. ASC also has a high degree of permanence, but has significant short-term risks and costs that are disproportionate to its benefits.

The most promising option for satisfying the MTCA and 1999 AO criteria is combining a practical and cost-effective source control method with downgradient groundwater control components. The PASC alternative adds an additional source control component, the gravity drain installed under the Closed CKD Pile, to the collection and treatment concept presented in the FGT alternative. The FGT components of the PASC alternative will achieve compliance with cleanup standards, whether the gravity drain is added or not. However, the gravity drain is practical, cost effective and reduces the volume of water that contacts the CKD. Despite the fact that the six alternatives meet the threshold evaluation criteria (Exhibit ES-4), PASC best balances the applicable remedy selection criteria. PASC will meet the cleanup standards with a significant degree of permanence and achieves the greatest benefit for the cost expended. PASC offers the following key advantages:

- Meets cleanup standards and ARARs, and therefore enhances the CKD closure systems to protect human health and the environment;

- Uses demonstrated and proven technologies that are technically and administratively implementable;

- Will reduce the volume of CKD-affected groundwater generated at the Site, giving this alternative one of the highest degrees of permanence;

- Avoids the short-term risks, implementability concerns, and high cost associated with PSR, the baseline alternative; and

- Includes practical and cost-effective source control, providing significant benefits at a proportionate cost.

Groundwater Remedy Recommendation

Because PASC meets the evaluation criteria, provides a source control component, is practical and implementable, has a high degree of permanence and achieves the greatest benefit for the cost expended, Lehigh proposes the PASC system as the preferred remedy for the Site. PASC meets MTCA threshold and balancing requirements. In addition, it is permanent to the maximum extent practicable. The components of PASC include:

- A gravity drain installed under the southern side of the Closed CKD Pile to intercept and divert groundwater from contacting the Closed CKD Pile;

- Downgradient hydraulic control to funnel the CKD-affected groundwater to the treatment zone;

- In situ treatment using a demonstrated technology;

- Construct the necessary support facilities in or around the Existing Building; and

- Institutional controls and additional monitoring activities, including: (a) warning signage; (b) fencing; (c) restrictive covenants; and (d) ongoing compliance monitoring.

Exhibit 4.8-1 presents a conceptual layout of the PASC remedy. The recommended PASC system use the following design and operating criteria:

- The gravity drain is a source control component that reduces the CKD-affected water requiring treatment;

- The groundwater treatment technology is a demonstrated technology that meets proposed cleanup levels and ARARs, and therefore protects human health and the environment;

- The treatment zone produces no residual waste that requires temporary on-site storage, transport and off-site disposal, thereby optimizing resource expenditures on operation and maintenance; and

- The funnel and gate components accommodate the complex hydrogeology at the Site by using engineered structures to direct water.

The PASC system will be maintained indefinitely.

Ecology will set the actual cleanup levels following finalization of the FSTR in the Cleanup Action Plan (CAP). Lehigh made the assumption for the purposes of this Revised dFSTR that Method A cleanup levels will apply to groundwater at the Site. Lehigh proposes the following with respect to cleanup standards:

- ***Cleanup Levels (CLs).*** The proposed cleanup levels relevant to the Site are pH in the range between 6.5 to 8.5, and a maximum arsenic concentration of 5.0 parts per billion.

- ***Point of Compliance (POC).*** Lehigh proposes a conditional point of compliance at a point downgradient of the PASC system and upgradient of Sullivan Creek. The POC follows the last treatment component of PASC and precedes Sullivan Creek.

The cleanup standards assumptions allowed Lehigh to evaluate and compare each alternative's ability to meet cleanup standards at the Site for the purposes of conducting a FS. The method of evaluating compliance with cleanup standards will be established during development of the monitoring program defined in the CAP and design phases of the project. As stated previously, Ecology will ultimately set the actual cleanup standards in the CAP.

SCHEDULE

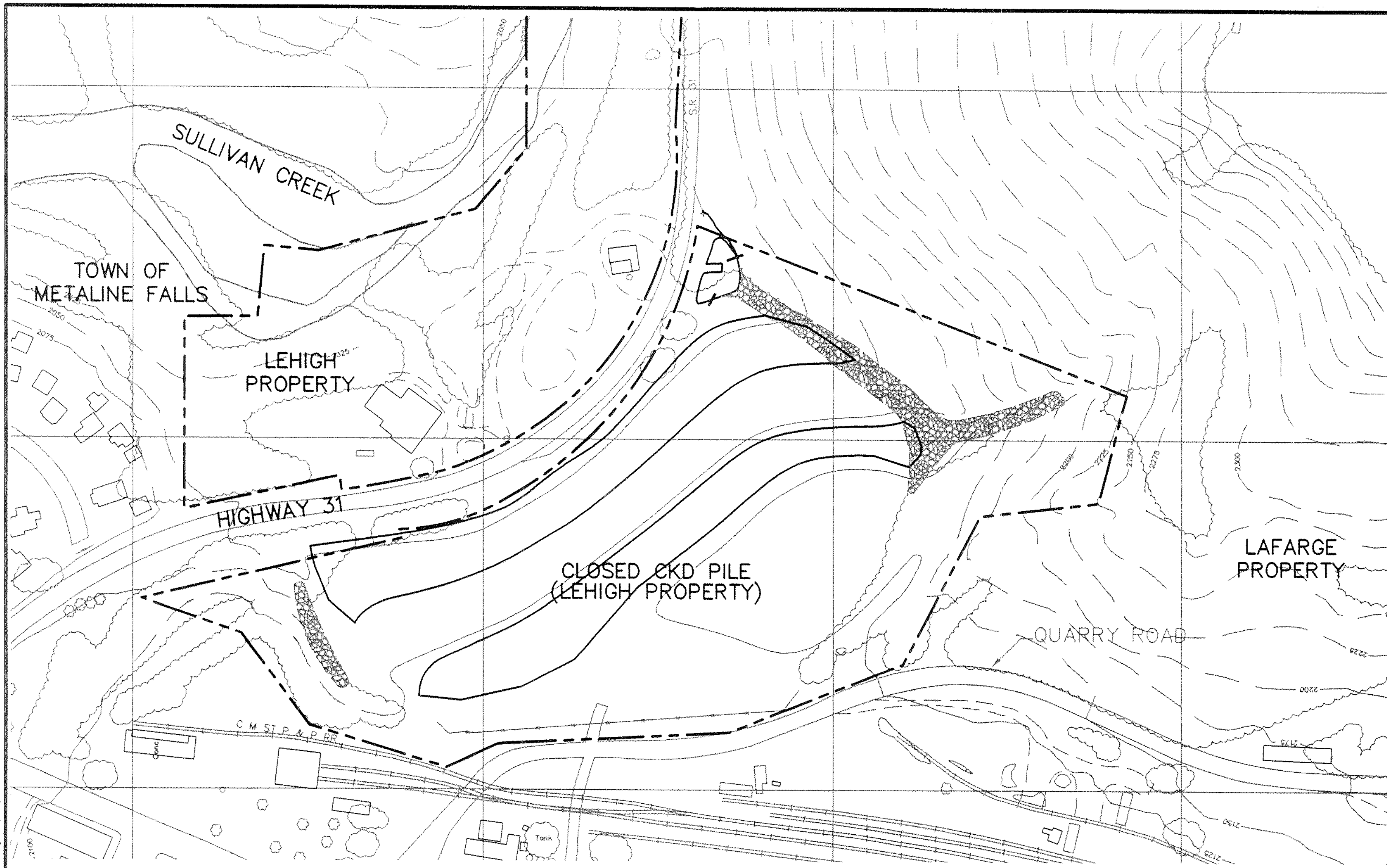
The actual construction schedule for the PASC Alternative will depend on:

- FSTR review process, including public comment;
- Preparation and approval of the draft CAP and consent decree;
- Regulatory review and permitting – particularly NPDES permitting;
- Specialty contractor availability; and
- Favorable weather conditions.

Lehigh analyzed the future project deliverables, scheduling milestones, and implementation timeframe for PASC. Lehigh believes that the PASC can be installed in summer 2006 (see Exhibit 6.4.1). Lehigh will work with Ecology to achieve this goal.

CONCLUSION

The preferred alternative, PASC, combines a source control component with in situ groundwater treatment that restores the localized groundwater downgradient of the Closed CKD Pile, allowing the Site to meet cleanup standards. PASC has a high degree of permanence, produces benefits that are not cost-disproportionate, is implementable, and uses a demonstrated treatment technology.



NOTE: CREEK ALIGNMENT IS APPROXIMATE.

GeoSyntec Consultants

SITE MAP
LEHIGH CEMENT COMPANY CLOSED CKD PILE
METALINE FALLS, WASHINGTON

EXHIBIT NO.	ES-1
PROJECT NO.	HR0196-12
DATE:	OCTOBER 2003

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EXHIBIT ES-2
SITE REMEDIES
REVISED DRAFT FEASIBILITY STUDY TECHNICAL REPORT
LEHIGH CEMENT COMPANY CLOSED CKD PILE
METALINE FALLS, WASHINGTON

Goals	Remedy Component	Date of Implementation
Isolate CKD to prevent direct contact exposure pathway.	Source Control, 7-acre engineered composite cover, surface water management system, and access control (fences and warning signs).	1995-96
Isolate CKD to prevent dust inhalation exposure pathway and nuisance dust.	Source Control, 7-acre engineered composite cover, surface water management system, and access control (fence and warning signs).	1995-96
Isolate high pH groundwater seeps near Highway 31 to prevent direct contact exposure pathway.	WDOT deck extension, engineered backfill.	1998
Restore groundwater aquifer downgradient of CKD pile.	Pilot in-situ permeable wall treatment.	Started in 2002
	Full-scale groundwater remedy installation.	Could be as early as 2006
Stop appearance of localized seeps near Sullivan Creek to prevent direct exposure.	Full-scale groundwater remedy installation. Access control.	Could be as early as 2006

DRAFT

Initial Alternative List for the FSTM:

1. CKD excavation and removal and off-site disposal
2. Limited CKD source removal
3. In situ containment by vertical CKD pile soil mixing/cement grouting
4. In situ containment by vertical CKD pile chemical grouting
5. In situ containment by horizontal/angled CKD pile soil mixing/cement grouting
6. In situ containment by horizontal/angled CKD pile chemical grouting
7. Source abatement by chemical infiltration
8. In situ neutralization by horizontal CKD pile drainage/buffering
9. In situ neutralization by metallic iron in situ permeable treatment wall
10. In situ neutralization by carbohydrate in situ permeable treatment wall
11. In situ neutralization by acid in situ permeable treatment wall-acid injection
12. In situ neutralization by carbon dioxide in situ permeable treatment wall
13. In situ neutralization by gaseous carbon dioxide in situ sparging points
14. In situ oxidation by pyrite in situ permeable reactive treatment wall
15. In situ oxidation by electrochemical water oxidation
16. Pump and treat with strong acid addition
17. Pump and treat with weak acid formation/addition (carbon dioxide (CO_2)/carbonic acid (H_2CO_3) addition)
18. Pump and treat with ferric chloride ($FeCl_3$) addition
19. In situ containment by slurry wall and hydraulic control
20. No further action

FSTM
[GeoSyntec, 2003b]

Final Alternative List from the FSTM:

1. Carbon Dioxide In Situ Permeable Treatment Wall
2. Gaseous Carbon Dioxide In Situ Sparging Points
3. Pump-and-Treat with Ferric Chloride Addition
4. Pump-and-Treat with Carbon Dioxide or Carbonic Acid Addition
5. Pump-and-Treat with Strong Acid Addition

Washington Department of Ecology (11 June 2003 Letter)

Request to consider "*Source Abatement Options*."
(re: Additional Source Control or Partial Source Removal)

Alternatives Evaluated in dFSTR:

1. Permeable Treatment Wall (PTW)
2. Pump-and-Treat (P&T)
3. Additional Source Control (ASC)
4. Partial Source Removal (PSR)
5. Groundwater Control (GWC)
6. Source and Seep Control (SSC)

Discussions and collaboration with the Washington Department of Ecology. Ecology's 4 January 2005 letter summarizes Ecology's expected final alternatives.

Final Alternatives Evaluated in Revised dFSTR:

1. Permeable Treatment Wall (PTW)
2. Groundwater Control (GWC)
3. Additional Source Control (ASC)
4. Partial Source Removal (PSR)
5. Funnel and Gate Treatment (FGT)
6. Partial Additional Source Control (PASC)

GEOSYNTEC CONSULTANTS

ALTERNATIVES FS SCREENING PROCESS
REVISED DRAFT FEASIBILITY STUDY TECHNICAL REPORT
LEHIGH CEMENT COMPANY CLOSED CKD PILE
METALINE FALLS, WASHINGTON

EXHIBIT NO.	ES-3
PROJECT NO.	HR0196-12
DATE	MARCH 2005

EXHIBIT ES-4
COMPARATIVE ANALYSIS OF ADDITONAL SITE REMEDY ALTERNATIVES
LEHIGH CEMENT COMPANY CKD PILE
METALINE FALLS, WASHINGTON

	#1 – PTW	#2 – GWC	#3 – ASC	#4 – PSR (Scenario 1)	#4 – PSR (Scenario 2)	#5 – FGT	#6 – PASC
	In situ groundwater treatment with carbon dioxide via diffusion.	Combination of existing Pilot System and approximately 16 P&T extraction wells.	Slurry wall upgradient of closed CKD pile; upgradient dewatering; downgradient P&T.	Remove and replace the following closed CKD pile portions: toe using sheet piles; middle bulk excavation. Groundwater treatments using GWC for 5 years.	Remove and replace the following closed CKD pile portions: toe using sheet piles; middle via bulk excavation. Groundwater treatment using GWC indefinitely.	Funnel downgradient groundwater to treatment using the in situ PTW technology	FGT combined with a gravity drain to intercept water prior to water-CKD contact and divert it away from the Closed CKD Pile.
OVERALL RATING	MODERATE	HIGH	LOW	LOWEST	LOWEST	MODERATE	VERY HIGH
WAC THRESHOLD CRITERIA							
Protect Human Health and the Environment	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Comply with Cleanup Standards	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Comply with ARARs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Provide for Compliance Monitoring							
Protection	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Performance	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Confirmation	Yes	Yes	Yes	Yes	Yes	Yes	Yes
OTHER WAC REQUIREMENTS							
Use of Permanent Solutions to the Maximum Extent Practicable	**Disproportionate Cost Analysis(1)**						
Protectiveness	Moderate-High	Moderate-High	High	Low	Low	Moderate-High	Highest
Permanence	High	High	Higher	Highest-Baseline(2)	Highest-Baseline(2)	High	Higher
Cost (in millions of dollars)(3)							
Implementation	$2.1	$1.1	$9.1 - $14	$17.4 - $24.2	$17.4 - $24.2	$2.3 - $2.6	$2.4 - $3.0
OMM	$2.2	$3.0	$3.2	$1.4	$3.0	$2.1	$2.1
Total	$4.3	$4.1	$12.3 - $17.2	$18.8 - $25.6	$20.4 - $27.2	$4.4 - 4.7	$4.5 - $5.1
Effectiveness over the Long Term	Moderate-High	Moderate-High	Moderate-Low	Low	High	Moderate-High	High
Management of Short-Term Risks	Easy	Easy	Difficult	Very Difficult	Very Difficult	Easy	Easy
Technical and Administrative Implementability	High	Moderate	Moderate – Low	Low	Low	Moderate	Moderate
Consideration of Public Concerns(4)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Disproportionate Cost Analysis Results	**Practicable, Moderate Permanence**	**Practicable, Moderate Permanence**	**Disproportionate Costs**	**Very Difficult, Disproportionate Costs**	**Very Difficult, Disproportionate Costs**	**Practicable, Moderate Permanence**	**Practicable, High Permanence**
Provide for a Reasonable Restoration Time Frame	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Consider Public Concerns(4)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1999 AO(5) OBJECTIVES							
Prevent Domestic Use of CKD-Affected Groundwater	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: (1) As defined in Washington Administrative Code 173-340-360(3)(e)
(2) PSR has the highest degree of permanence. This Revised dFSTR evaluates the alternatives based on two groundwater treatment scenarios.
(3) Appendix E lists elements of the alternatives that were included in the cost estimates. Costs presented here for a 30-year project duration using a 7 percent discount rate. The detailed cost tables (Exhibits 4.1-8, 4.3-2, 4.4-2, 4.5-2, 4.6-2, 4.7-2, and 4.8-2), show results for other project durations and discount rates.
(4) The public will be provided with opportunities to comment on project documents. Ecology will address public comments before finalizing this document.
(5) Agreed Order DE99HS-E941